Sample Syllabus

ME 400 Thermodynamics of Propulsion and Power Systems
Fall 2025

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Class TA/Grader: Juan Pablo Murrieta Cortes (jpm7706@psu.edu)

Class Schedule: MoWeFr 10:10AM - 11:00AM (Willard Bldg 165)

Office Hours: Instructor office hours (basic concepts, grading): Monday 11:30 am – 12:30 pm (306 Reber)
TA office hours (homework problems): Thursday 5:00 –6:00 pm (127 Hammond)

Textbook: Thermodynamics, an Engineering Approach, 9th Ed.*, Y.A. Cengel and M.A. Boles, McGraw Hill, 2018.

Description: Analysis of applied thermodynamic systems, including gas power cycles, vapor power cycles, combined power cycles, refrigeration cycles, air conditioning cycles, gas mixtures, air-water vapor mixtures, chemical reactions, combustion, and renewable energy sources.

Course URL: Course materials, schedule, and homework assignments can be accessed at: canvas.psu.edu (The front page will assist you to access course materials.

Pre-requisites: Prerequisite: ME 300 and ME 320; Prerequisite or concurrent: ME 410

Grading:

Homework (5)		50%
In-class exams (5)		50%
Total		100%
Late drops prior to first exam	-WN	
Late drops after first exam:		
-With a score ≥ 60%	-WP	
-With a score < 60%	-WF	

Grading Scale:

Grades	Points	Explanation
A A-	93 - 100 90 – 92	Excellent performance, superior achievement
B+ B B-	87 – 89 83 – 86 80 – 82	Good performance, substantial achievement
C+ C	77 – 79 70 – 76	Standard performance and achievement

D	60 – 69	Substandard performance, marginal achievement
F	0 - 59	Unsatisfactory performance and achievement

* Expected class average: **79**

Academic Dishonesty:

Academic dishonesty will not be tolerated *at all*. I hope that everyone can develop enough pride in his or her own work and abilities that this will never be a problem. When you earn an Engineering degree from Penn State, the University is certifying that you are capable of performing engineering duties at a professional level. Course grades are the sole basis on which the College of Engineering certifies your degree with the assumption that your course grades are a valid assessment of your own knowledge and abilities. If you have cheated, you have falsified that credential. Therefore, we must have academic integrity expectations to ensure the validity of your grade and your degree. It is encouraged, however, to discuss problems solving techniques with classmates in remote study groups and during office hours. Evidence of academic dishonesty will be dealt with by University Policy 49-20, described at: https://advising.engr.psu.edu/student-resources/academic-integrity.aspx. Unauthorized use of a solutions manual is a deliberately dishonest act. The instructor will follow sanctioning guidelines for all cases of violations of academic integrity, which can be found at https://undergrad.psu.edu/aappm/sanctioning-guidelines.html. Students who are found to be dishonest will be reported to the University's Office of Student Conduct for disciplinary sanctions.

Problem format (Homework, Exams):

All homework and exam questions should be solved using the following format.

> *KNOWN*: List properties, variables, etc. given in the problem.
> *FIND*: What is unknown that we are asked to find.
> *SKETCH*: Schematic diagram and relevant graphs (P-v, T-s diagrams, etc.).
> *ASSUMPTIONS*: These need to be justified if they are atypical.
> *ANALYSIS*: Solve the problem, step-by-step, and always include units. Box the final answer.
> *SANITY CHECK*: Miscalculations can lead to unrealistic results. Indicate if you feel that your answer is not realistic!

You can submit the homework at any time before the submission deadline. The homework solutions and grading rubrics will be posted on Canvas one day after the homework submission deadline at 1 pm. Significant point deduction (20-80 points out of 100) will be applied to late homework that is submitted before the time when the solution manual is posted. Late submissions after the homework solutions are posted will NOT be accepted and result in a score of zero.

In-Class Exams:

There will be five in-class exams. The exam problems will be based on homework/class example problems and include conceptual questions related to what was taught during the lectures. Property tables will be provided by the instructor. One exam may be replaced by a final project. Physical copies of your worksheets will be collected and graded. Late submissions will not be accepted.

Make-Up Exam/Quizzes:

Make-up work for missed exams and/or homework will be only allowed for medical emergency cases. Provision of the doctor's letter will be mandatory to submit make-up work. Online doctor notes will not be accepted.

Attendance:

Due to the nature of this course and the fact that the exam and test materials will be discussed in class, it is assumed that those who regularly attend lectures *will do much better*; therefore, attendance is very important.

Contesting Grades:

Grades must be appealed via email *within one week* after you receive your assignment score. You must review the grading rubrics posted on Canvas, scan your entire worksheet, and send an email to the instructor that clearly describes the grading error.

Classroom Rules:

- Additional announcements and changes to the policy and syllabus (if needed) will be made in class.
- Absolutely *no cell phones and laptops* should be used during class – this includes texting/messaging. Please remember to turn your phone off before class starts. *Violation including each cell phone ring will result in 3 points deduction for the upcoming exam.*
- For all exams, any form of violation of academic integrity will be directly reported to the University's Office of Student Conduct.
- Tardiness is disruptive – please make every attempt to be in class on time. If you are late for the in-class exams, *you will not be given extra time*.

Additional Info:

Penn State welcomes students with disabilities into the University's educational programs. If you have a disability-related need for reasonable academic adjustments in this course, contact the Office for Disability Services (ODS) at 814-863 1807 (V/TTY). For further information regarding ODS, please visit the Office for Disability Services Web site at http://equity.psu.edu/ods/.

In order to receive consideration for course accommodations, you must contact ODS and provide documentation (see the documentation guidelines at http://equity.psu.edu/ods/guidelines/documentation-guidelines). If the documentation supports the need for academic adjustments, ODS will provide a letter identifying appropriate academic adjustments. Please share this letter and discuss the adjustments with your instructor as early in the course as possible. You must contact ODS and request academic adjustment letters at the beginning of each semester.

Course Objective:

(1) Use the principles of thermodynamics to carry out detailed analyses of thermodynamic power cycles, including:

a. Simple Rankine steam cycle with ideal and actual processes
b. Reheat Rankine steam cycle with ideal and actual processes
c. Regeneration processes in actual steam power cycles, including systems with multiple open and closed feedwater heaters

d. Spark-ignitionenginesusingtheair-standardandcold-air-standardOttocycles
e. Compression-ignition engines using air-standard and cold-air-standard Diesel cycles
f. Gas turbine engines using the air-standard and cold-air-standard Brayton cycles

(2) Use the principles of thermodynamics to analyze ideal and actual refrigeration cycles, including:
a. Vapor-compression refrigeration processes operating under ideal and actual conditions
b. Heat pump processes operating under ideal and actual conditions
c. Innovative vapor-compression refrigeration systems, such as ones with multi-stage arrangements, flash chambers, and mixing chambers.

(3) Use the principles of thermodynamics to analyze and solve combustion problems, including:
a. Chemical balances in combustion systems
b. Energy balances in combustion systems
c. Determination of adiabatic flame temperatures
d. Determination of composition balances in reacting systems at chemical equilibrium at different temperatures

(4) Use the principles of thermodynamics to analyze and solve problems involving mixtures of water vapor and air, including:
a. Water-spray cooling processes
b. Wet cooling tower processes
c. Humidifying and de-humidifying air conditioning processes

(5) Understand and apply second law principles, such as availability and irreversibility for chemical reaction analysis, and for performance analysis of devices such as gas power cycles, vapor power cycles, refrigeration cycles, and two-phase air conditioning cycles.

(6) Identify contemporary sustainability issues related to thermodynamic analysis of different energy systems, such as economic, social, and environmental impacts. Quantify the impact of energy systems on natural resources, such as the amount of fossil fuel required to operate a power plant under certain cycle parameters, or the amount of water required to operate a given cooling tower.

(7) Perform design-related analysis on a number of engineering components, such as: (i) cooling towers, (ii) refrigerators, (iii) air conditioners, (iv) internal combustion engines, (v) evaporative cooling devices, (vi) steam power plants, (vii) feedwater heater systems for steam power plants, and (viii) gas burners. Here, design is the process in which analysis, iteration, judgment, and engineering fundamentals are used to make choices between different engineering parameters such as geometry characteristics, flow rates, energy capacities, and second law compatibility to meet specific performance and operation requirements, or other outside limitations. Discuss qualitatively the trade-offs between these different requirements, and make recommendations based on your knowledge and calculations.

Week	Class #	Date	Day	Topics	Chapters	Exams
1	1	Aug. 25	M	Syllabus, Overview		
	2	Aug. 27	W	Review of Thermo I – Properties of pure substances	1	
	3	Aug. 29	F	Review of Thermo I – Properties of pure substances	2	
2		Sep. 1	M	**Labor Day**		
	4	Sep. 3	W	Review of Thermo I – First law, Work and Heat	3	
	5	Sep. 5	F	Review of Thermo I – First law, Work and Heat	4, 5	
3	6	Sep. 8	M	Review of Thermo I – Second law	6	
	7	Sep. 10	W	Review of Thermo I – Second law	6	
	8	Sep. 12	F	Review of Thermo I – Entropy	7	HW 1
4	9	Sep. 15	M	Review of Thermo I – Entropy	7	Exam 1
	10	Sep. 17	W	Intro to gas power cycle	9.1 -3 (6.3, 6.7-10)	
	11	Sep. 19	F	Otto cycle I	9.3-5	

5	12	Sep. 22	M	Otto cycle II (1)	9.5	
	13	Sep. 24	W	Otto cycle II (2)	9.5	
	14	Sep. 26	F	Diesel cycle	9.6	
6	15	Sep. 29	M	Brayton cycle I	9.8	HW 2
	16	Oct. 1	W	Brayton cycle II	9.8-9	
	17	Oct. 3	F	Brayton cycle III	9.10	Exam 2
7	18	Oct. 6	M	Rankin cycle I (1)	10.1-3	
	19	Oct. 8	W	Rankin cycle I (2)	10.1-3	
	20	Oct. 10	F	Rankin cycle II	10.4-6	
8	21	Oct. 13	M	Rankin cycle III (1)	10.6	
	22	Oct. 15	W	Rankin cycle III (2)	10.6	
	23	Oct. 17	F	Combined cycle	10.8-9	
9	24	Oct. 20	M	Refrigeration cycle I (1)	11.1-4	HW 3
	25	Oct. 22	W	Refrigeration cycle I (2)	11.1-4	
	26	Oct. 24	F	Refrigeration cycle II	11.4-5	Exam 3
10	27	Oct. 27	M	Second-law analysis of cycles (1)	8.1-3, 10.7, 11.5	
	28	Oct. 29	W	Second-law analysis of cycles (2)	8.1-3, 10.7, 11.5	
	29	Oct. 31	F	Gas mixtures	13.1-3	
11	30	Nov. 3	M	Gas-vapor mixtures I (1)	14.1-3	
	31	Nov. 5	W	Gas-vapor mixtures I (2)	14.1-3	
	32	Nov. 7	F	Gas-vapor mixtures II	14.4-5	
12	33	Nov. 10	M	Gas-vapor mixtures III	14.6-7	HW 4
	34	Nov. 12	W	Gas-vapor mixtures IV	14.7	
	35	Nov. 14	F	Chemical reactions I	15.1-2	Exam 4
13	36	Nov. 17	M	Chemical reactions II (1)	15.2	
	37	Nov. 19	W	Chemical reactions II (2)	15.2	
	38	Nov. 21	F	Chemical reactions III	15.1	
14		Nov. 24	M	**Thanksgiving Holiday**		
		Nov. 26	W	**Thanksgiving Holiday**		
		Nov. 28	F	**Thanksgiving Holiday**		
15	39	Dec. 1	M	Chemical reactions IV (1)	15.4-5	
	40	Dec. 3	W	Chemical reactions IV (2)	15.4-5	
	41	Dec. 5	F	Chemical reactions V	15.3	
16	42	Dec. 8	M	Chemical reactions VI (1)	15.4-5	HW 5
	43	Dec. 10	W	Chemical reactions VI (2)	15.4-5	
	44	Dec. 12	F	Chemical reactions VII	15.6 (7)	Exam 5
17		Dec. 15		**Final exam week**	**N/A**	**N/A**

STATEMENT ON ACADEMIC INTEGRITY

It is a simple matter of personal integrity, but unfortunately there are a few out there that have no personal pride in their own work. Earning a C is far more satisfying than stealing an A. Academic honesty and integrity is of utmost importance. Detailed information on this topic can be found at www.engr.psu.edu/undergrad/acad_int/students. Some examples are given below:

CHEATING: Using crib sheet; pre-programming a calculator; using notes or books during a closed book exam etc.
COPYING ON TEST: Looking at another unsuspecting student's exam and copying; copying in a complicit manner with another student; exchanging color-coded exams for the purpose of copying; passing answers via notes; discussing answers in exam, etc.
PLAGIARISM: The fabrication of information and citations; submitting others work from professional journals, books, articles and papers; submission of other students papers or lab results or project reports and representing the work as one's own; fabricating in part or total, submissions and citing them falsely, etc.

ACTS OF AIDING OR ABEADING: Facilitating acts by others; unauthorized collaboration of work; permitting another to copy from exam; writing a paper for another; inappropriately collaborating on home assignment or exam without permission or when prohibited, etc.
UNAUTHORIZED POSSESSION: Of examinations, through purchase or supply; stealing exams; failing to return exams on file; selling exams; photocopying exams; buying exams; any possession of an exam without the custodian's permission, etc.
SUBMITTING PREVIOUS WORK: Submitting a paper, case study, lab report or any assignment that had been submitted for credit in a prior class without the knowledge and permission of the instructor.
TAMPERING WITH WORK: Changing own or another students work product such as lab results, papers, or test answers; tampering with work either as a prank or in order to sabotage another work, etc.
GHOSTING: Taking a quiz, an exam, performing a laboratory exercise or similar evaluation in place of another; having another take a quiz, an exam, or perform an exercise or similar evaluation in place of the student, etc.
ALTERING EXAMS: When instructor returns graded exams for in class review and subsequently collects them, student changes incorrect answers and seeks favorable grade adjustment asserting that instructor made mistake in grading; other forms may include changing the letter or and/numerical grade on test; obtaining test in discretely, etc.
COMPUTER THEFT PROGRAM: Electronic theft of computer programs, data, or text belonging to another etc.

STATEMENT ON ACCOMODATIONS FOR STUDENTS WITH DISABILITIES
Penn State welcomes students with disabilities into the University's educational programs. Every Penn State campus has an office for students with disabilities. The Office for Disability Services (ODS) Web site provides contact information for every Penn State campus: http://equity.psu.edu/ods/dcl. For further information, please visit the Office for Disability Services Web site: http://equity.psu.edu/ods.
In order to receive consideration for reasonable accommodations, you must contact the appropriate disability services office at the campus where you are officially enrolled, participate in an intake interview, and provide documentation: http://equity.psu.edu/ods/doc-guidelines. If the documentation supports your request for reasonable accommodations, your campus's disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.